Available online at www.sciencedirect.com
SCIENCE DIRECT®
Veterinary Parasitology 132 (2005) 179–183
veterinary parasitology
www.elsevier.com/locate/vetpar

Trichinae certification in the United States pork industry

David G. Pyburn [a,*], H. Ray Gamble [b], Elizabeth A. Wagstrom [c], Lowell A. Anderson [a], Lawrence E. Miller [a]

[a] *USDA APHIS VS, 210 Walnut Street, Suite 891 Des Moines, IA 50309, USA*
[b] *National Academy of Sciences, 2001 Wisconsin Avenue, N.W., Washington DC 20007, USA*
[c] *National Pork Board, 1776 N.W. 114 Street, Clive, IA 50325, USA*

Abstract

Control of *Trichinella* infection in U.S. pork has traditionally been accomplished by inspection of individual carcasses at slaughter or by post-slaughter processing to inactivate parasites. We propose that an alternative to individual carcass testing or processing can be used when pigs are raised in production systems where risk of exposure to *Trichinella spiralis* has been mitigated. Declines in prevalence of this parasite in U.S. domestic swine during the last 30 years, coupled with improvements in pork production systems, now allow *Trichinella* control to be shifted to the farm through implementation of specific pork production practices. Knowledge of risk factors for exposure of swine to *T. spiralis* was used to develop an objective audit of risk that can be applied to pork production sites. In a pilot study, 461 production site audits were performed by trained veterinary practitioners. The on-farm audit included aspects of farm management, bio-security, feed and feed storage, rodent control programs and general hygiene. Of the 461 production site audits, 450 audits (97.6%) indicated compliance with the required good production practices. These sites are eligible for certification under the U.S. Trichinae Certification Program and will be audited regularly to maintain that status. The described trichinae certification mechanism will establish a process for ensuring the *Trichinella* safety of swine, and ultimately food products derived from swine, at the production level.

Keywords: Food safety; Trichinae; Pork; Trichinellosis; Pre-harvest pork safety; On-farm certification program

1. Introduction

Prevention of human trichinellosis is a public health goal and there are numerous international standards for testing and treating pork to prevent human infection. Individual carcass testing has been an effective method for preventing clinical trichinellosis in humans in many countries, but the cost of testing is substantial (Pozio, 1998). In developed countries, modern pork production systems have all but eliminated trichinellosis as a food safety risk. In recognition of this, alternatives to individual carcass testing are now being explored for documentation of pork safety. Groups including the International Commission on Trichinellosis (ICT), the Office Internationale des Epizooties (OIE) and the European Union Veterinary Working Group are considering these alternatives. It is with this background that the

* Corresponding author. Tel.: +1 515 284 4122; fax: +1 515 284 4191.
E-mail address: david.g.pyburn@aphis.usda.gov (D.G. Pyburn).

0304-4017/$ – see front matter © 2005 Elsevier B.V. All rights reserved.
doi:10.1016/j.vetpar.2005.05.051

United States Department of Agriculture (USDA) and the U.S. pork industry are developing the U.S. Trichinae Certification Program.

Food safety is a high priority for the U.S. government and the U.S. pork industry. Significant investments in food safety research, education and abatement programs have been made by both the U.S. government and pork producers. In an effort to further ensure the safety of U.S. pork, research projects have been ongoing over the last 8 years to identify and control the risk factors for trichinae at the farm level. The USDA has worked with the National Pork Board and the pork processing industry to utilize knowledge from this research to develop a federal regulatory program, the U.S. Trichinae Certification Program. The U.S. Trichinae Certification Program is a pork safety program that provides documentation of pork production management practices that minimize the risk of exposure of pigs to *Trichinella spiralis*. It is an alternative to individual carcass testing that can be used when pigs are raised in production systems where risk of exposure to *T. spiralis* has been eliminated.

2. Materials and methods

2.1. Program components and criteria

Knowledge of risk factors for exposure of swine to *T. spiralis* were used to develop an objective audit of on-farm production practices that could be applied to pork production sites (Gamble and Bush, 1999; Gamble et al., 1999, 2000, 2001; Van Knapen, 2000). The on-farm audit includes aspects of farm management, bio-security, feed and feed storage, rodent control programs and general hygiene. In a pilot study, objective measures of these good production practices were obtained through review of production records and an inspection of the production site. Four hundred and sixty-one production site audits were performed by veterinary practitioners. These veterinarians had previously been trained on auditing procedures, *Trichinella* risk factor identification, and *Trichinella* Good Production Practices (Trichinae Certification Pilot Program Standards, 2001 and Trichinae Certification Pilot Program Auditor Handbook, 2001). Site-specific trichinae certification was granted or denied each of the pork production sites dependent upon the outcome of the audit. Program sites will be audited on a regular schedule as established by the Trichinae Certification Pilot Program Standards. In the same pilot study, verification testing of swine raised on certified sites was subsequently performed at slaughter using an ELISA test. Verification testing is random testing of a statistically valid sample of swine from Trichinae Certified production sites using the entire certified population delivered to the slaughter plant on a yearly basis to determine the total number of samples needed. This testing is performed to verify that the swine coming from Trichinae Certified production sites are free of *Trichinella*. Verification testing of swine from audited production sites was performed by trained laboratory technicians at the slaughter plant.

The Good Production Practices that are employed and audited in the Trichinae Certification Program are as follows:

1. All non-breeding swine entering the site have either originated from certified pork production sites or, in the case of swine less than 5 weeks old, have originated from either a certified or non-certified pork production site. The source herd Trichinae Identification Number (TIN) must be documented in an animal movement record.
2. Sources of feed or feed ingredients meet Good Manufacturing Practices, as defined in this program or quality assurance standards recognized by the feed industry and documentation to this effect are maintained at the site.
3. Swine feed supplies at the site must be prepared, maintained and handled in a manner such that the feed is protected from possible exposure to or contamination by rodents or wildlife. An up-to-date rodent control logbook documenting these practices is maintained at the site.
4. Exclusion and control of rodents and wildlife at the site are to a level such that fresh signs of activity of these animals are not observed in the swine production or feed preparation and storage areas. The producer maintains at the site an up-to-date rodent control logbook with a site diagram, or maintains comparable records from a Pest Control Operator. All records are updated on at least a monthly basis.

5. Wildlife carcasses are not intentionally fed to swine. Swine shall not have access to wildlife harborage or carcasses on the site. This harborage limitation includes wood lots and other natural wildlife access areas.
6. If meat-containing waste is fed to swine, the pork production site must hold a State license to feed such waste. Cooking times and temperatures must be consistent with State and Federal regulations and up-to-date records of waste feeding and cooking practices must be maintained at the site. Cooked waste products that are stored prior to feeding must not be contaminated with uncooked material. Uncooked household waste must not be fed to swine.
7. Procedures are in place and are carried out that call for the prompt removal and proper disposal of swine carcasses found in pens in order to eliminate the opportunity for cannibalism, as well as to prevent attraction of rodents or wildlife.
8. General hygiene and sanitation of the production site is maintained at all times such that rodents and wildlife are not attracted.
   - Solid waste (facility refuse) must be contained in covered receptacles and regularly removed from the site to prevent rodent and wildlife access and attraction.
   - Spilled feed must be regularly removed and properly disposed of.
9. Animal arrivals and departures from the site must be documented in an animal movement record and take place in a manner that ensures that swine can be traced to/from that particular certified production site.
10. All records required under the Trichinae Certification Program must be up-to-date and must be readily available for inspection at the enrolled or certified pork production facility (Trichinae Certification Pilot Program Standards, 2001).

In the program, pork production sites are audited by USDA qualified and accredited veterinarians. The purpose of these audits is to observe and collect information about the production site, pig sources, feed sources, feed storage methods, rodent and wildlife control, carcass disposal procedures and facility hygiene. Information is collected on USDA approved official program audit forms. The USDA regulates the audits to ensure that the program standards are met and certifies that the specified Good Production Practices are in place and are maintained on the audited pork production sites. USDA maintains a database containing program records for each certified site. USDA also maintains oversight of the auditing process by qualifying program auditors and by conducting random spot audits. Spot audits are intended to verify that the program's Good Production Practices are maintained between scheduled audits and to assure that the audit process is conducted with integrity and in a consistent manner across the program.

In the program, in order for pigs originating from certified sites to be sold into commerce, the swine slaughter facility must have in place a procedure by which pigs from certified sites and edible pork products derived from pigs from certified sites are segregated from pigs and edible pork products originating from non-certified sites. This process is verified by the USDA Food Safety and Inspection Service. Swine slaughter facilities processing pigs from certified sites are responsible for conducting verification testing to confirm the trichinae-free status of those pigs originating from certified production sites. On a regular basis, statistically valid samples of pigs from certified herds are tested at slaughter to verify that on-farm trichinae-infection risk reduction practices are working. This process verification testing is performed using a USDA approved tissue or blood-based post-mortem test, and is regulated by the USDA Agricultural Marketing Service.

3. Results

Of the 461 production site audits, 450 audits (97.6%) indicated compliance with the good production practices as defined in the program, and these sites were granted status in the program (''enrolled'' or ''certified''). Random verification testing of 11,713 swine from farms in the pilot certification program resulted in 11,712 negatives and one positive by ELISA. The one positive ELISA result was determined to be a false–positive when a 5 g sample of diaphragm from the carcass was tested by artificial digestion.

4. Discussion

T. spiralis is a parasitic nematode affecting animals and man. The disease caused by this parasite, trichinellosis, is acquired by consuming encysted larvae in the muscle tissue of an infected animal. Consumption of undercooked pork has traditionally been a common source of trichinellosis in humans worldwide. In the U.S. the prevalence of this organism in pigs has dropped sharply due to changes in swine production practices within the U.S. pork industry. The USDA National Animal Health Monitoring System's National Swine Survey in 1995 showed an infection rate of 0.013% (Gamble and Bush, 1999). The same survey in 2000 demonstrated that the infection rate in U.S. swine had fallen to 0.007% (Bush, personal communication).

In the mid-1980's the convergence of three factors provided a powerful rationale for the development of industry supported programs to improve food safety in the U.S. pork industry. First, the prevalence of *Trichinella* in U.S. swine had reached such a low level that disease free status could be envisioned. Second, there was recognition by U.S. pork industry leaders that international markets were closed to U.S producers and U.S. pork products because of the inaccurate perception that U.S. produced pork had a comparatively high risk of harboring *Trichinella*. Finally, the development of a rapid, ELISA-based diagnostic test provided a relatively inexpensive tool, which could be utilized for verification testing in a control program.

The U.S. Trichinae Certification Program is an on-farm certification program for the assurance of pork product safety with regards to *T. spiralis*. The U.S. Trichinae Certification Program is based on scientific knowledge of the epidemiology of *T. spiralis* and numerous studies demonstrating how specific Good Production Practices can prevent exposure of pigs to this zoonotic parasite. It is consistent with recommended methods for control of *Trichinella* in domestic pigs as described by the International Commission on Trichinellosis (Gamble et al., 2000, 2001). Among the issues covered in that document are methods of trichinae-free certification through on-farm Good Production Practices. The document states, ''Modern swine production systems reduce or eliminate risks for infection of pigs with *Trichinella* and testing of animals raised under these conditions is unnecessary. There are minimal requirements which need to be met for livestock to be considered trichinae free-based on husbandry'' (Gamble et al., 2000, 2001). The document then lists the pork production management practices that are required. The U.S. Trichinae Certification Program meets or exceeds these requirements.

The U.S. Trichinae Certification Program is regulated by the United States Department of Agriculture. Collaborative efforts of the Animal and Plant Health Inspection Service (APHIS), the Food Safety Inspection Service (FSIS) and the Agricultural Marketing Service (AMS) verify that certified pork production sites manage and produce pigs according to the requirements of the program's Good Production Practices and verify the identity of pork from the certified production unit through slaughter and processing. Uniform pilot program standards stating the requirements of this pilot program have been developed. Additional federal regulations in support of the program are currently being developed. The completion of the pilot phase described here will lead to implementation of a federally regulated program throughout the U.S.

The U.S. Trichinae Certification Program will document the safety of pork produced under scientifically proven production methods by ensuring risk factors exposing swine to *T. spiralis* have been eliminated. The safety of pork originating from pigs not raised under the standards of this program will continue to be assured through existing methods of carcass testing, cooking, irradiation and/or freezing.

References

Gamble, H.R., Bessonov, A.S., Cuperlovic, K., Gajadhar, A.A., Van Knapen, F., Noeckler, K., Schenone, H., Zhu, X., 2000. International commission on trichinellosis: recommendations on methods for the control of *Trichinella* in domestic and wild animals intended for human consumption. Vet. Parasitol. 93, 393–408.

Gamble, H.R., Brady, R.C., Bulaga, C.L., Berthoud, W.G., Smith, W.G., Detweiler, L.A., Miller, L.E., Lautner, E.A., 1999. Prevalence and risk association for *Trichinella* infection in domestic pigs in the northeastern United States. Vet. Parasitol. 82, 59–69.

Gamble, H.R., Bush, E., 1999. Seroprevalence of *Trichinella* infection in domestic swine based on the National Animal Health

Monitoring System's 1990 and 1995 swine surveys. Vet. Parasitol. 80, 303–310.

Gamble, H.R., Pyburn, D.G., Anderson, L.A., Miller, L.E., 2001. Verification of good production practices that reduce the risk of exposure of pigs to *Trichinella*. Parasite 8, S233–S235.

Pozio, E., 1998. Trichinellosis in the European Union: epidemiology, ecology and economic impact. Parasitol. Today 14, 35–38.

Pyburn, D.G., 2002. *Trichinella* certification in the U.S. pork industry. In: Proceedings of the 17th International Pig Veterinary Society Congress, vol. 1. p. 267.

Trichinae Certification Pilot Program Auditor Handbook, 2001. Copyrighted Publication of USDA and the National Pork Board.

Trichinae Certification Pilot Program Standards, 2001. Copyrighted Publication of USDA and the National Pork Board.

Van Knapen, F., 2000. Control of trichinellosis by inspection and farm management practices. Vet. Parsitol. 93, 385–392.